to the muffle, and since then has operated in a satisfactory manner, the following points being worthy of note:

1. In spite of the large size of the muffler, its temperature was absolutely uniform, and no differences of temperature could be detected between the different portions of the furnace, by the use of a Le Chatelier pyrometer;
2. By the operation of a damper, this temperature could be regulated very accurately within a wide temperature range (900° to 400°) ;
3. The quantity of fuel consumed (55 kg 80 per hour) corresponded exactly with the computed fuel consumption.

The only trouble with this furnace resulted from the intermittent operation to which it was subjected. This caused bending and warping of the muffle which failed completely after about two months' service, necessitating replacement. That this warping was entirely due to the intermittent operation of the furnace is borne out by the fact that a vertical muffle for practically the same class of work, installed in a furnace in the Poutiloff works, which is operated continuously, lasts about fourteen months.

In order to eliminate the trouble in the furnace at the Petrograd Arsenal the muffle was removed and the openings in the hearth for the removal of the waste gases were relocated. This furnace works very nicely for tempering and annealing, but it is no longer a muffle furnace. Finally the furnace was reconstructed with a new muffle constructed of special thin bricks, and since that time no operating troubles have developed.

XII. VERTICAL FURNACES FOR TEMPERING, ANNEALING AND HEAT TREATING

The application of the downdraft idea has nowhere given such brilliant results as when applied to vertical furnaces, and there is

no other form of furnace which gives so little satisfaction and so much trouble as a vertical tempering furnace. The reason for this is very simple. In every works " the heat-treating depart-ment " is the " forbidden ground " of the plant. Secrets, secrets and secrets! As a matter of fact, the men who possess these secrets always know less than those who do not possess them.

Nevertheless, tempering and annealing furnaces only require a working temperature varying from 800° to 1000° and—good or bad—they may be operated. With regard to the heat-treating